Remarks

Claims 1-30 are pending.

No amendments are presented with this Response.

The Office action requests clarification regarding "exactly what the interrupt signal is doing in comparison with the way other interrupts are used." To resolve the issues the Examiner requests a flow chart illustrating several steps of a spin coating process and showing how the interrupt signal and timers function.

Attachments A, B, and C are included with the following comments.

Serial process control

The invention relates generally to improvements in process control systems for spin-coating, over conventional systems that functions using "serial process control" alone. Serial process control is a control system that controls based on sequentially executing a series of steps or subroutines, in order, with each step involving any one or more of data input, computation, comparison, and outputs.

Figure 1 of the original application shows an example of a general serial control system, the example being a "round robin" control algorithm such as could be useful with a PC or "personal computer" controller. With the illustrated serial control, a process is performed according to a defined sequence of subroutines. Each subroutine includes instructions for, e.g., a status check of a parameter or function, data storage, data comparison, or executing a function such as a process command. After proceeding through one subroutine, the serial control moves to a next subroutine and continues in a defined order through all subroutines, in a particular order.

Another example of a serial, round-robin, control methodology is that used by a Programmable Logic Controller, or PLC, as shown in Attachment A. In an "input" step, the PLC receives status information regarding a group of relevant parameters, functions, and systems, for an apparatus being controlled, such as a spin coating apparatus; all inputs are received during this portion of the control process. In a next "compute" step the process control system performs all calculations relating to control of the apparatus. In a next step,

the "output" step, the control system addresses the apparatus to control functions. The system then returns to the "input" stage, receives input, etc.

As discussed in the patent application, these types of serial control can be susceptible to timing variability (e.g., in the range of microseconds) due to the time between steps. See, e.g., the application as filed, such as at the two paragraphs starting at page 4, line 10, and continuing to the top of page 5.

Claims 1, 9, 22, and their dependent claims

The invention of claim 1 relates to a process control system that functions using "serial process control," which includes sequentially executing a series of subroutines, but that also includes interrupting the serial control to performing at least one function outside of the serial control system, e.g., using a separate "interrupted control" system separate from the serial control series of steps and subroutines.

A non-limiting, exemplary diagram of how this method may be used with a spin-coating system is illustrated with Attachment B, showing a spin coating system that includes: a process control system ("PCS") having a serial process control portion and a non-serial portion (e.g., interrupted control); and a spin coating apparatus that is controlled by the overall process control system.

Attachment C is a flow diagram that shows exemplary steps between process control portions of a PCS as illustrated at Attachment B. A PCS may operate under serial control with subroutines, etc. Upon a trigger event or interrupt signal, the PCS exits serial control and uses non-serial control.

All diagrams are schematic and are not intended to show all features (inventive or otherwise) of a control system, a spin coating apparatus of the invention, or of subject matter of the above-identified patent application or claims.

According to the method of claim 1, a system is controlled using a serial control portion, and the serial control portion is interrupted by an interrupt signal, whereupon the PCS exits serial control and executes a process command. With reference to Attachment B, the PCS functions using serial control by, for example, coursing through sequential subroutines, data analysis, function analysis, command steps, etc., and at some point will be

interrupted by an "interrupt signal," such as from the spin coater. The interrupt signal causes the PCS to exit the serial control portion and to use the non-serial control portion to perform a process command.

The interrupt signal can generally be based on any feature or parameter of the spin coating system, and may be a software interrupt (e.g., detected during serial control), or a hardware interrupt that is hard-wired into the spin coating apparatus or a component of the apparatus, or may be something different. Upon receiving the interrupt signal, the controller stops and exits serial control. The controller can record its position and set up for re-entering serial control (after executing one or more process commands outside of serial control). According to claim 4, after executing a process command by process control outside of the serial control portion, the PCS can re-enter serial control, e.g., based on the information and status of the system at the exit function.

As discussed in the application as filed, such as at the two paragraphs starting at page 4, line 10, and continuing to the top of page 5, serial control can introduce variability in timing between process commands.

The use of non-serial control, or interrupted control, as discussed in the patent application, can reduce that variability.

Claims 10-20

Inventions of claim 10 and its dependent claims involve a method of controlling spin-coating that is an alternative to serial control methods, e.g., that can be used in conjunction with a serial control method.

The method of claim 10 differs from serial control in that the claim 10 method directly executes one or more process command using a time schedule based on an earlier event, and without a series of subroutines. An example of the method of claim 10 is shown at figures 6 and 7 of the application.

Figure 6 illustrates two different process commands being executed at two different moments following one (i.e., the same) "trigger event." Upon the trigger event (t=0), one or more timers are set and after duration D1 a first movement is performed and after duration D2 a second command is performed. In contrast to the illustrated serial control of Figure 1,

the Figure 6 control system does not perform subroutines that may include steps such as a status check of a parameter or function, data storage, or data comparison. The Figure 6 control system directly performs command steps at specific durations, allowing for reduced variability in the timing of steps compared to serial process control.

Figure 7 illustrates a similar set of commands, executed after durations measured from a single trigger event, Figure 7 including 6 commands as opposed to 2 commands of figure 6.

As is explained in the patent application, the process control systems of Figures 6 and 7 are example control systems that could be used as an "interrupt service routine" (ISR) upon interrupting a serial control process. With reference to Attachment B, the process control of either of Figures 6 or 7 could be used in the illustrated example of a spin coating apparatus as part of the non-serial control portion of the PCS.

Claim 21

Claim 21 recites a method of controlling a spin-coating process using an interrupt service routine having at least two timers.

According to claim 21, a PCS may use serial control, and the serial control may be interrupted to execute a series of commands referred to as an "interrupt service routine," such as is illustrated in Figure 6, 7, or as otherwise described. With reference to Attachment B, the PCS can control using serial control until an interrupt signal occurs, and then the PCS transfers to control using non-serial control with at least two timers, such as is exemplified in either of Figures 6 or 7.

Figures 4 and 5 of the application generally illustrate a change from serial control to an ISR, e.g., as recited in claim 21. Figure 4 shows serial control starting at time zero and lasting until about a time between 14 and 15 seconds, which is indicated as a start of a "process sync area" represented by line 68. During the processing within the process sync area, the PCS can use an interrupt service routine to perform functions based two or more timers, outside of a serial control regime. At the end of the ISR, i.e., at the end of the time of line 68, serial control can be resumed.

Figure 5 is similar, with line 88 of Figure 5 representing a process sync area controlled by non-serial control.

Other claims

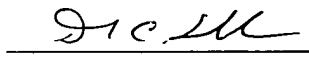
The above remarks and discussion also relate to features of the remaining claims.

Conclusion

It is respectfully submitted that the claims and the present application are in condition for allowance. Approval of the application and allowance of the claims are earnestly solicited.

In the event that a phone conference between the Examiner and the Applicant's undersigned attorney would help resolve any remaining issues in the application, the Examiner is invited to contact the undersigned at (651) 275-9806.

Respectfully Submitted,

By: 

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Dated: April 10, 2006

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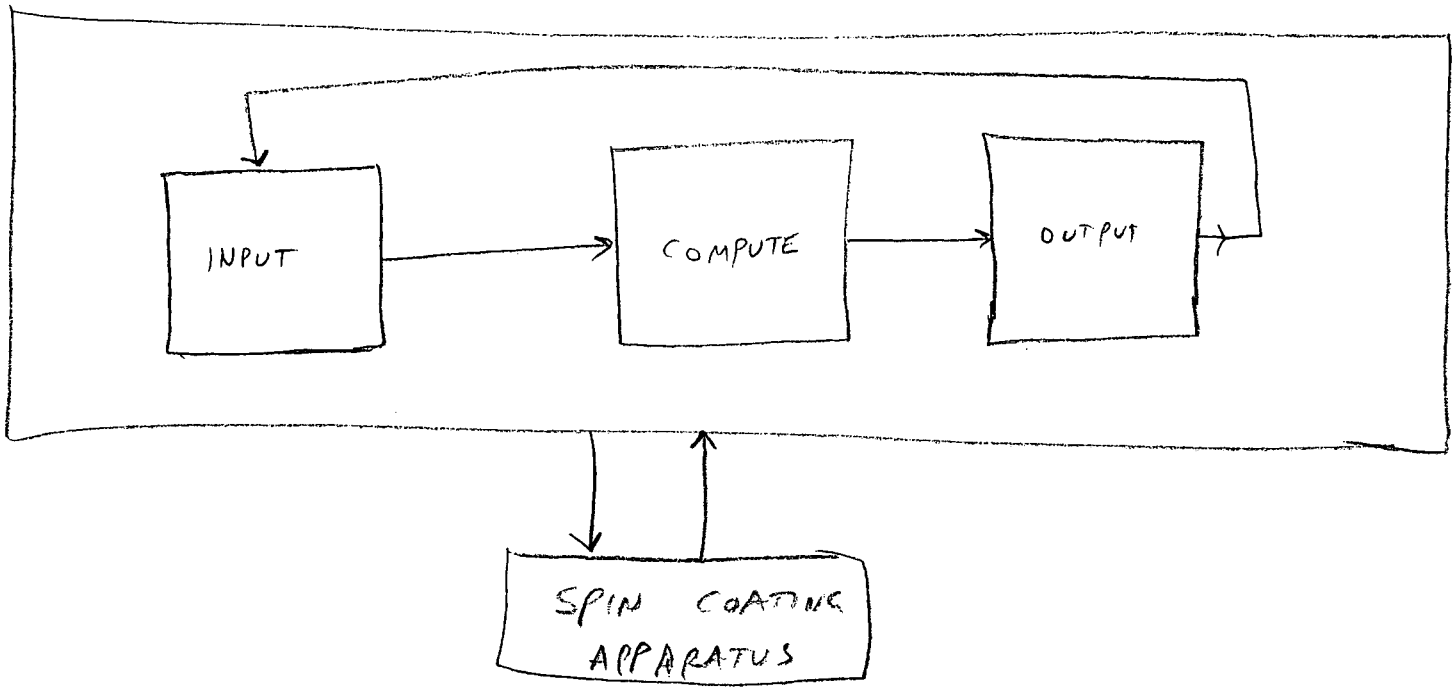
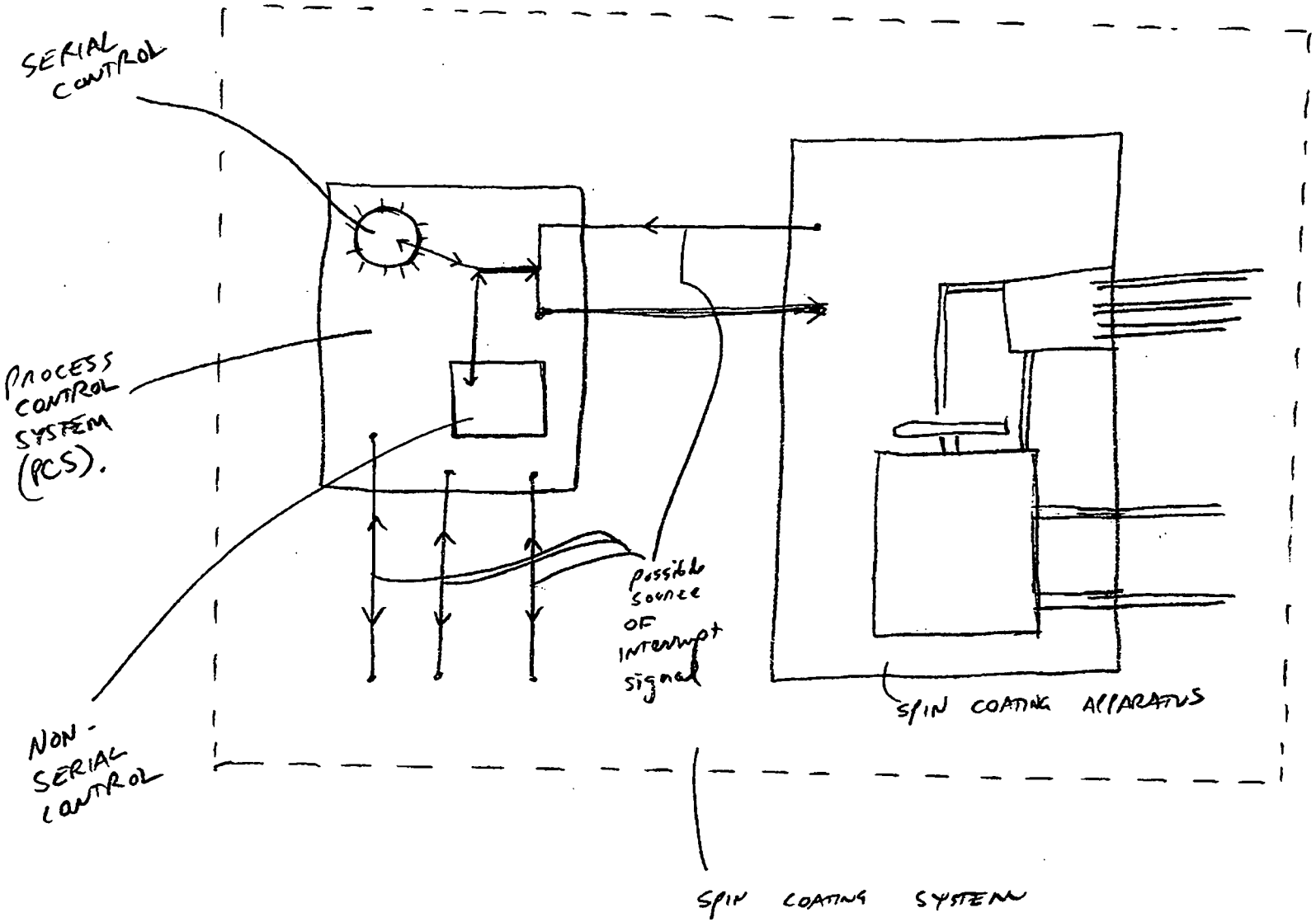
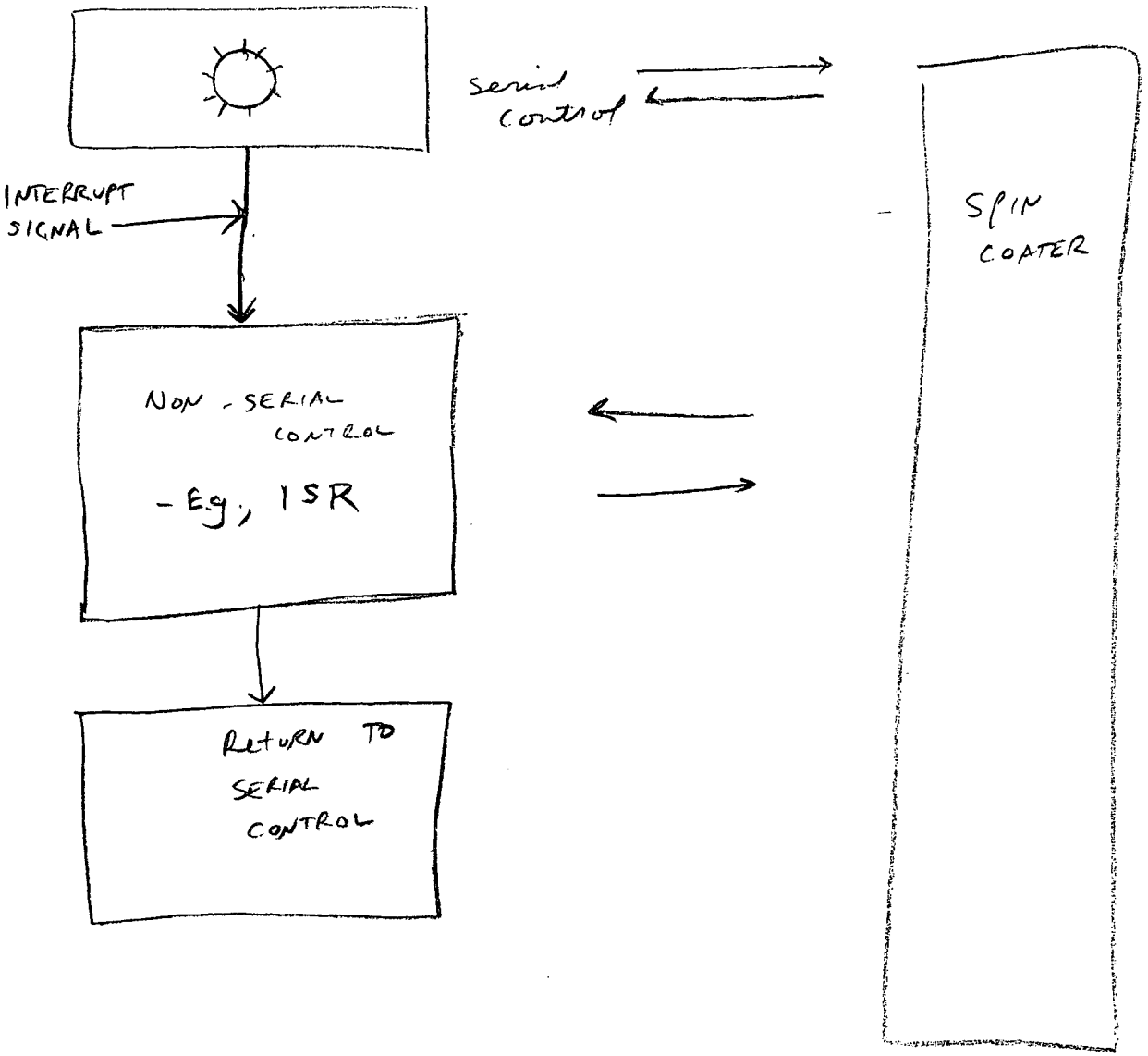


ATTACHMENT A

ATTACHMENT B





ATTACHMENT C